(54) Title: METHOD FOR PERFORMING DISCONTINOUS TRANSMISSION IN AN ASYNCHRONOUS TRANSFER MODE
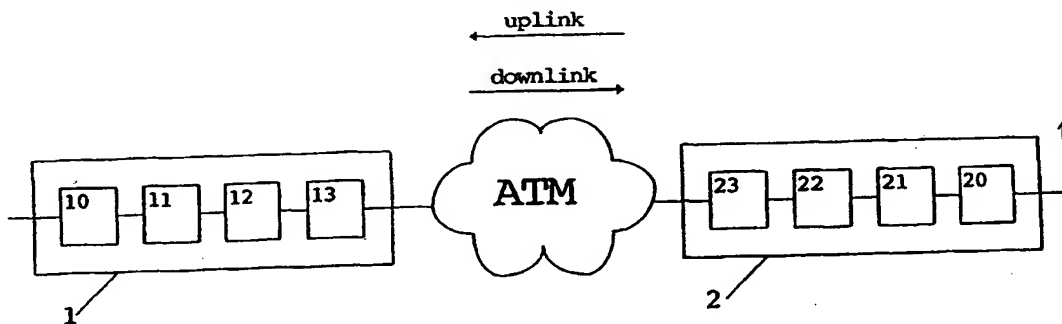
(57) Abstract

A method for performing a discontinuous transmission in an asynchronous transfer mode is described, wherein a downlink transmission of an ATM cell is performed each time a predetermined number of signal frames indicating a speechless period has been supplied, and wherein an uplink transmission of an ATM cell is only performed when a signal frame indicating a useful information has been supplied. In the downlink transmission, an idle frame can be generated at the receiving end, when no ATM cell is received. In the uplink transmission, a signal frame indicating a useless information can be generated, when no ATM cell is received. Thereby, only those signal frames required at the receiving end are transmitted. Moreover, known transmission functions and elements of a synchronous transmission system can be used at the respective ends of transmission.

Method for performing discontinous transmission in an asynchronous transfer mode

- 1 -

FIELD OF THE INVENTION

The present invention relates to a method for performing discontinuous transmission in an asynchronous transfer mode

5   (ATM), and particularly to a Discontinuous Transmission (DTX) for full-rate speech traffic channels in an ATM based GSM BSS network using GSM network elements.

BACKGROUND OF THE INVENTION

10

In a GSM network, signal transmission is performed between a mobile station (MS) and a Base Station Subsystem (BSS) comprising a Transcoder (TC) for encoding/decoding transmitted information and a Base Transceiver Station (BTS)

15   for receiving/transmitting radio signals from/to the MS within a predetermined cell. Typically, the BTS and the TC are wire-connected using a synchronous PCM (Pulse Code Modulation) connection.

20   In a discontinuous transmission (DTX) mode, transmission is automatically interrupted in a speechless period to thereby reduce power consumption and interference of neighbouring cells.

25   During such speechless periods, Silence Descriptor frames (SID frames) comprising background noise information are transmitted. Thus, a receiver may bridge speechless periods by generating a noise signal (comfort noise) adapted to the background noise. In the GSM TDMA (Time Divisional Multiple

30   Access) system, these SID frames are transmitted at reduced intervals (eg. every 480 ms) as compared to the usual GSM

- 2 -

frame period during speech periods (4.615 ms in an air interface and 20 ms in the BSS).

A known DTX method of the synchronous PCM connection is described in the following.

According to the GSM system, a full rate speech frame (TRAU frame) consists of 40 octets (0-39) of 8 bit length, comprising speech parameter and flag information. Additionally, two octets of PCM synchronization information are provided at the beginning of the frame. The flag information of the TRAU frame comprises the following flags:

FLAG	BIT	FRAME POSITION	MEANING
SID (LSB)	C14	bit 7, octet 3	silence descriptor flag
SID (MSB)	C13	bit 6, octet 3	(two bit information)
BFI	C12	bit 5, octet 3	bad frame indication flag
SP	C16	bit 7, octet 38	speech flag
TAF	C15	bit 8, octet 3	time alignment flag
DTX	C17	bit 8, octet 38	discontinuous trans-mission flag

The SID, BFI and TAF flag only exist in an uplink TRAU frame and the SP flag only in a downlink TRAU frame, whereas the DTX flag exists in both TRAU frame types.

In the downlink direction, i.e. from the TC to the BTS, the TC sets a speech flag (SP flag) in the TRAU frame to thereby indicate whether the TRAU frame contains speech or not. In case of speech, the SP flag is set to "1", otherweise to "0".

In the case of SP=0, the TRAU frame contains information used for generating comfort noise. The first TRAU frame containing SP=0 is transmitted to an air interface (radio transmitter) at the BTS and thereafter the transmission is stopped.

5   However, the TC continues transmitting the comfort noise information to the radio transmitter at the BTS which transmits one frame every 480 ms. As soon as SP=1, continuous transmission is again started.

10   In an uplink direction, i.e. from the BTS to the TC, the BTS uses the BFI flag in the TRAU frame to indicate whether the TRAU frame contains a useful or a useless speech information, wherein BFI=1 indicates the useless speech information. The frame might have been modified during radio transmission

15   such that the received speech parameters are destroyed.

When the TC receives a TRAU frame with BFI=1, the speech parameters of the current TRAU frame are replaced by the speech parameters of the previous TRAU frame. In case of

20   several subsequent TRAU frames with BFI=1, a muting function is activated.

The SID flag of the TRAU frame consists of two bits and is used by the BTS to indicate whether the TRAU frame contains

25   speech or not. SID=00b ("b" indicates binary information) indicates that the TRAU frame contains speech information, whereas SID=10b indicates that information for generating comfort noise is contained. SID=01b indicates that the SID frame has been modified and that a previous one needs to be

30   used.

- 4 -

Thus, if, for example, a TRAU frame with BFI=1 is received after a TRAU frame with SID=10b, the comfort noise generation is continued.

5   The TAF flag indicates whether the TRAU frame is aligned with a multiframe timing of a control channel (eg. SACCH, Slow Associated Control CHannel) to be used for exchanging control and measurement parameters between the MS and the BSS. In practice, during an uplink DTX, TAF=1 is in the same frame as

10   SID=10b, because signaling is transmitted in the same air frame as the silence descriptor.

The DTX flag is assumed to be always set to "1", since discontinuous transmission is always performed in both

15   directions.

In ATM based GSM networks, the TC and the BTS are connected via an asynchronous ATM (Asynchronous Transfer Mode) connection. In an ATM connection, bit streams of binary

20   signals of different channels are divided into unitary ATM cells to be transmitted in a time divisional manner.

SUMMARY OF THE INVENTION

25   It is an object of the present invention to provide a method for discontinuous transmission over an ATM connection.

This object is achieved by a method for performing discontinuous transmission in an asynchronous transfer mode

30   ATM, comprising the steps of performing a downlink transmission of an ATM cell each time a predetermined number of signal frames indicating a speechless period have been

- 5 -

supplied, and performing an uplink transmission of an ATM
cell only when a signal frame indicating a useful information
has been supplied.

5   According to the above described known system, useless signal
frames are replaced by previous ones in an uplink
transmission and the comfort noise signal frame is radio
transmitted in the downlink direction at a reduced rate.

10   Since the above solution according to the present invention
suggests transmitting only ATM cells containing signal frames
required by the known synchronous system, known DTX functions
and elements can be used, when a discontinuous transmission
is implemented. Thus, implementation costs can be reduced.

15

An idle speech frame may be generated, when no ATM cell has
been received at a receiving end of the downlink
transmission.

20   Furthermore, a frame indicating a useless information
preferably can be generated, when no ATM cell has been
received at a receiving end of the uplink transmission.

According to a preferred development, the last signal frame
25   received at the receiving end of the downlink transmission
and indicating a speechless period is repeated, when the
number of ATM cells not received at the receiving end of the
downlink transmission corresponds to said predetermined
number of signal frames after which an ATM cell is
30   transmitted.

- 6 -

As an example, this can be achieved by a counter which is initialized each time an ATM cell containing a signal frame indicating a speechless period has been received, and which is incremented each time no ATM cell has been received.

5

Furthermore, a time alignment flag can be set at the receiving end of the uplink transmission, when the number of ATM cells received or missed since the last setting of the time alignment flag corresponds to the predetermined number

10 of signal frames.

As an example, this can be achieved by a counter which is initialized when an ATM cell containing a set time alignment flag is received at the receiving end, and which is

15 incremented each time an ATM cell is received or missed at the receiving end.

By the above additional measures, possible cell losses in the ATM connection are taken into account.

20

Preferably, said predetermined number is determined on the basis of a discontinuous transmission period during said speechless period.

25 This provides the advantage that an additional synchronization of the ATM cell period with the discontinuous transmission period is not required.

30

- 7 -

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described in greater detail on the basis of a preferred embodiment with reference to the accompanying drawings in which:

Fig. 1 shows a schematic block diagram of a TC and BTS connected via an ATM connection;

Fig. 2 shows a state diagram for downlink DTX transmitter functions of the TC according to the preferred embodiment;

Fig. 3 shows a state diagram for downlink DTX receiver functions in the BTS according to the preferred embodiment of the present invention,

Fig. 4 shows a state diagram for uplink DTX transmitter functions in the BTS according to the preferred embodiment of the present invention,

Fig. 5 shows another state diagram for uplink DTX receiver functions in the TC according to the preferred embodiment of the present invention, and

Fig. 6 shows a state diagram for uplink DTX receiver functions in the TC according to the preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The following asynchronous DTX functions may be part of a control program provided for a control means or may be

- 8 -

implemented as a hardware ATM interface for the BTS and TC of a BSS.

In the present preferred embodiment, the described
5   asynchronous DTX functions take advantage of the DTX functions already implemented in a current TC and BTS connected via a synchronous connection.

Fig. 1 shows a block diagram of a BSS comprising a TC 1 and a
10 BTS 2 connected via an ATM connection. The TC 1 comprises a current or usual TC 10 already used in synchronuous connection systems and a conversion means 11 for performing a conversion between the TRAU frame used in the usual TC 10 and an asynchronous ATRAU frame (ATM-TRAU frame) used in an ATM
15 cell of the ATM connection. The ATM-DTX functions are implemented in a DTX control means 12 which performs a conversion between the above described current DTX functions and the ATM-DTX functions. Finally, an ATM interface 13 is provided for connecting the TC 1 to the ATM connection.
20
The BTS 1 has a similar structure comprising a current or usual BTS 20, a conversion means 21 for performing conversion between the ATRAU and TRAU frame, a DTX control means 22 for implementing ATM-DTX functions and an ATM interface 23.
25
In Fig. 1, uplink and downlink directions are indicated by arrows.

In the following, the method according to the preferred
30 embodiment of present invention will be described by means of state diagrams defining actions performed by the DTX control means 12 and 22, respectively. Therein, each state includes

an action of reading the ATRAU frame received from the ATM connection, BTS 2 or TC 1 after the action mentioned in the diagram.

5   The transition from one state to another is triggered according to the indicated state of flag bits of a frame currently read. The symbol "&" defines a logical "and" which means that the state transition is triggered when both requirements are met. Each state period in the state diagrams

10 preferably has the same duration and preferably equals to the ATM cell period.

Actually, the ATM cell rate which defines the total number of ATM cells per second depends on the TRAU frame rate. In case

15 of a one-to-one mapping relationship, one TRAU frame is inserted into one ATM cell. Thus, the ATM cell period corresponds to the TRAU frame period, which is 20 ms (50 TRAU frames per second) during speech periods and 480 ms during speechless periods.

20

In the ATM specifications, a so-called ATM adaptation layer (AAL) is defined as a standard layer which allows multiple applications to have their data converted to and from the ATM cell. A protocol is used that translates higher layer

25 services into the size and format of an ATM cell.

The above one-to-one relationship can be achieved, for example, by an ATM adaptation layer type 5 (AAL5) or without any adaptation layer ("AAL0") where ATM frames are just put

30 to ATM cells.

- 10 -

However, the present invention can be implemented in an ATM adaptation layer type 2 (AAL2) as well. In this case, a so-called AAL2 minicell rate has to be considered rather than the ATM cell rate.

5

Thus, the ATM interfaces 13 and 23 in Fig. 1 preferably may be "AAL0", AAL2 or AAL5 interfaces.

The ATRAU frame may consist of 35 octets comprising a speech
10   parameter information and the following flag information:

FLAG	BIT	FRAME POSITION	MEANING
SID (LSB)	C14	bit 4, octet 33	silence descriptor flag
SID (MSB)	C13	bit 3, octet 33	(two bit information)
BFI	C12	bit 2, octet 33	bad frame indication flag
TAF	C15	bit 5, octet 33	time alignment flag
DTX	C17	bit 6, octet 33	discontinuous trans-mission flag

The conversion means 11 of the TC 1 as well the conversion means 21 of the BTS 2 perform conversion such that a speech
15   flag SP=1 in the TRAU frame results in a silence descriptor flag SID=00b=0d in the ATRAU frame and that a speech flag SP=0 (TRAU frame) results in a silence descriptor flag SID=10b=2d (ATRAU frame), wherein "d" indicates a decimal number.
20

Throughout the following description, the flag states will be indicated by means of decimal numbers, wherein a corresponding indication will be omitted.

- 11 -

In the following, ATM-DTX functions in the downlink direction
will be described.

Fig. 2 shows a state diagram for the ATM-DTX transmitter
5   functions of the DTX control means 12 in the TC 1 in a
downlink transmission from TC 1 to the ATM connection.

In the present case, BFI=0 is assumed and SID=1 should not
occur, since a radio transmission of the frame was not yet
10   performed.

According to Fig. 2, the ATRAU frame is transmitted to the
ATM connection via the ATM interface 13 as long as an ATRAU
frame containing speech information (SID=0) is transmitted.

15

In case of an ATRAU frame containing a comfort noise
information (SID=2), only an ATM cell containing the first
ATRAU frame is transmitted, wherein subsequent ATRAU frames
with SID=2 lead to an initialization of a counter (i=0) and
20   thereafter to a successive incrementation until the counter
has counted to i=24. When i=24 has been reached, an ATM cell
containing the corresponding ATRAU frame is transmitted to
the ATM connection and the processing starts again as long as
subsequent ATRAU frames with SID=2 are transmitted.

25

However, as soon as an ATRAU frame with a speech information
(SID=0) is received, the DTX control means 12 is reset to its
initial state where an ATM cell is transmitted for every
ATRAU frame.

30

Accordingly, in speechless periods where SID=2, an ATM cell
is only transmitted over the ATM connection every 24 state

- 12 -

periods. In view of the fact that the state period is 20 ms,
the above processing leads to a transmission of an ATM cell
with a comfort noise ATRAU frame every 480 ms, as required
according to the DTX specifications. Thus, an additional
5   synchronization is not required.

Fig. 3 shows a state diagram for the ATM-DTX receiver
functions of the DTX control means 22 in the BTS 2 in a
downlink transmission from the ATM connection to the BTS 2.

10

The state initially provided in the DTX control means 22 is
to pass an ATRAU frame extracted from an ATM cell received by
the ATM interface 23 to the usual BTS 20 via the conversion
means 21. This initial state is maintained as long as ATM
15   cells are received.

When no ATM cell is received, the DTX control means 22 is
switched to another state where idle ATRAU frames are
inserted until the next ATM cell is received.

20

Furthermore, a cell loss handling processing is provided,
wherein a comfort noise information is repeated when no ATM
cells are received. This can be achieved by repeating
previous SID frames.

25

In the present case, a counter is additionally initialized
(i=0) as soon as an ATM cell containing an ATRAU frame with
SID=2 (comfort noise) is received. For every subsequent
missing ATM cell, the counter is incremented and the last
30   SID=2 ATRAU frame is repeated until a counting result "24"
indicating a time period of 480 ms has been reached.

- 13 -

If no ATM cell is received when i=24, the last SID=2 ATRAU frame is again repeated and the counter is reset to zero (i=0). For every subsequent missing ATM cell, the above processing is repeated. If an ATM cell containing an ATRAU
5   frame with SID=2 (comfort noise) is received when i=24, the new SID=2 frame is passed and the counter is reset to zero. In this case, the above processing is repeated for the new SID=2 frame.

10   During the above described cell loss handling procedure, any receipt of an ATM cell containing an ATRAU frame with SID=0 (speech information) leads to a reset of the DTX control means 22 to its initial state.

15   Accordingly, after the receipt of an ATM cell containing a comfort noise ATRAU frame with SID=2 and as long as no further ATM cell is received, this frame is repeatedly passed to the usual BTS 20 for 24 state periods of 20 ms, resulting in a DTX period of 480 ms.
20
When an ATM cell containing a new comfort noise ATRAU frame (SID=2) is received after the 24th frame, the new comfort noise ATRAU frame is repeatedly passed as long as no subsequent ATM cell is received and the above processing is
25   repeated until an ATM cell containing a speech ATRAU frame (SID=0) is received.

By the above described processing, comfort noise frames with the required DTX time period of 480 ms are provided even if
30   no ATM cells are received.

- 14 -

As an alternative, the repetition of previous SID frames
could be performed in the BTS 2 or the MS. In this case,
however, an idle speech frame handling performed in the BTS 2
or the MS has to be adapted correspondingly.

5

In the following, ATM-DTX functions in the uplink direction
are described.

Fig. 4 shows a state diagram for DTX transmitter functions of
10 the DTX control means 22 in the BTS 2 in an uplink
transmission from the BTS 2 to the TC 1.

In the initial state, an ATM cell containing an ATRAU frame
corresponding to a TRAU frame received by the usual BTS 20
15 and converted by the conversion means 21 is transmitted to
the ATM connection as long as the BFI flag of the current
ATRAU frame is zero, i.e. the frame information has not been
destroyed during radio transmission.

20 However, BFI=1 indicates that the frame is an unusable speech
frame or an invalid SID frame which does not have to be
transmitted over the ATM connection. Thus, ATRAU frames with
BFI=1 are discarded and no ATM cells are transmitted until a
new ATRAU frame with BFI=0 is received and the DTX control
25 means 22 is reset to its initial state.

Accordingly, in the ATM-DTX uplink transmitter function, no
ATM cell is transmitted as long as ATRAU frames with BFI=1
are received.

30

- 15 -

Fig. 5 shows a state diagram for the ATM-DTX receiver
functions of the DTX control means 12 in the TC 1 in an
uplink transmission from the ATM connection to the TC 1.

5   Initially, the DTX control means 12 is set to a state where
an ATRAU frame of an ATM cell received from the ATM interface
13 is passed to the usual TC 10 via the conversion means 11.
This initial state is maintained as long as ATM cells are
received.

10
In case no ATM cell is received, the DTX control means 12 is
switched to a another state where an ATRAU frame with a BFI
flag set to "1" is generated until the next ATM cell is
received and the DTX control means 12 is reset into its

15   initial state.

Fig. 6 shows another state diagram for the ATM-DTX receiver
functions of the DTX control means 12 in the TC 1 in an
uplink transmission from the ATM connection to the TC 1. In

20   this case, the usual TC 10 does not have to handle missing
TAF=1 frames, since the corresponding processing is performed
by the DTX control means 12.

In the initial state, the DTX control means passes ATRAU

25   frames with TAF=0 of received ATM cells to the usual TC 10
until an ATM cell containing an ATRAU frame with TAF=1
indicating a timing alignment is received and the state of
the DTX control means 12 is changed.

30   In the new state, the TAF=1 frame is also passed to the usual
TC 10 and, additionally, a counter is now reset to zero. With
any subsequently received ATM cell, the counter is

- 16 -

incremented and the contained ATRAU frame is passed to the
usual TC 10 until a count value "24" has been reached. When
an ATM cell is received and i=24, the corresponding ATRAU
frame is passed to the usual TC 10 and the counter is reset
5   to zero.

By the above processing, the counter is synchronized to the
TAF=1 frames. Thus, only the state of the counter and the
presence or absence of ATM cells needs to be considered in
10 the following processing.

When no ATM cells are received after the initial
synchronization of the counter, ATRAU frames with BFI=1
indicating a bad frame are generated and the counter is
15 incremented until the count value has reached "24".

When ATM cells are received before the counter has reached
i=24, the corresponding ATRAU frames are passed to the usual
TC 10 while the counter is still incremented with any
20 received ATM cell.

In any case, when i=24 and no ATM cell has been received, an
ATRAU frame with TAF=1 and BFI=1 is generated and the counter
is reset to zero. Thereafter, the above processing is
25 repeated.

Accordingly, in the ATM-DTX uplink receiver function, ATRAU
frames with BFI=1 are generated when no ATM cells are
received. Furthermore, a counter may be synchronized to a
30 TAF=1 frame and an ATRAU frame with TAF=1 and BFI=1 may be
generated any time the counter reaches the value of "24" and
no ATM cell has been received. Thereby, the initially

- 17 -

described known processings for bad TRAU frames can be
performed in the usual TC 10.

5   It is obvious that a similar processing can be performed in
half rate speech traffic channels to thereby implement
discontinuous transmission over ATM connections using current
GSM network elements.

Moreover, direct switching from the BTS 2 to another BTS can
10   be performed without using the TC 1, if the ATM-DTX functions
of the DTX control means 12 of the TC 1 are provided in the
DTX control means 22 of the BTS 2.

In summary, a method for performing a discontinuous
15   transmission in an asynchronous transfer mode is described,
wherein a downlink transmission of an ATM cell is performed
each time a predetermined number of signal frames indicating
a speechless period have been supplied, and wherein an uplink
transmission of an ATM cell is only performed when a signal
20   frame indicating a useful information has been supplied.
In the downlink transmission, an idle frame can be generated
at the receiving end, when no ATM cell is received. In the
uplink transmission, a signal frame indicating a useless
information can be generated, when no ATM cell is received.
25   Thereby, only those signal frames required at the receiving
end are transmitted. Moreover, known transmission functions
and elements of a synchronous transmission system can be used
at the respective ends of transmission.

30   It should be understood that the above description and
accompanying figures are only intended to illustrate the
present invention. Thus, the method and apparatus according

to the invention may also be used in systems other than the described GSM system. The preferred embodiment of the invention may vary within the scope of the attached claims.

Claims:

5   1.   A method for performing discontinuous transmission in
an asynchronous transfer mode ATM, comprising the steps of:
         performing a downlink transmission of an ATM cell each
time a predetermined number of signal frames indicating a
speechless period have been supplied; and

10   performing an uplink transmission of an ATM cell only
when a signal frame indicating a useful information has been
supplied.

2.   A method according to claim 1, wherein an idle speech
15   frame is generated, when no ATM cell has been received at a
receiving end of the downlink transmission.

3.   A method according to claim 2, wherein the last signal
frame received at the receiving end of the downlink
20   transmission and indicating a speechless period is repeated,
when the number of ATM cells not received at the receiving
end of the downlink transmission corresponds to said
predetermined number of signal frames after which an ATM cell
is transmitted.

25

4.   A method according to claim 3, wherein a counter is
initialized each time an ATM cell containing a signal frame
indicating a speechless period has been received, and wherein
said counter is incremented each time no ATM cell has been
30   received.

-20-

5.   A method according to claim 1, wherein a frame
indicating a useless information is generated, when no ATM
cell has been received at a receiving end of the uplink
transmission.

5

6.   A method according to claim 4, wherein a time alignment
flag (TAF) is set at the receiving end of the uplink
transmission, when the number of ATM cells received or missed
since the last setting of the time alignment flag corresponds
10   to said predetermined number of signal frames.

7.   A method according to claim 6, wherein a counter is
initialized when an ATM cell containing a set time alignment
flag is received at the receiving end, and wherein said
15   counter is incremented each time an ATM cell is received or
missed at the receiving end.

8.   A method according to any one of the preceding claims,
wherein said predetermined number is determined on the basis
20   of a discontinuous transmission period during said speechless
period.

9.   A method according to any one of the preceding claims,
wherein said uplink and downlink transmission is performed in
25   a GSM system between a transcoder and a base transceiver
station.

10.   A method according to claim 9, wherein a bad frame
indicator flag (BFI) of a GSM speech frame is used to
30   indicate a useless information in said uplink transmission.

11. A method according to claim 8 or 9, wherein a silence predictor flag (SID) of a GSM speech frame is set on the basis of a speech flag (SP) of said GSM speech frame, and wherein said silence predictor flag is used to indicate said
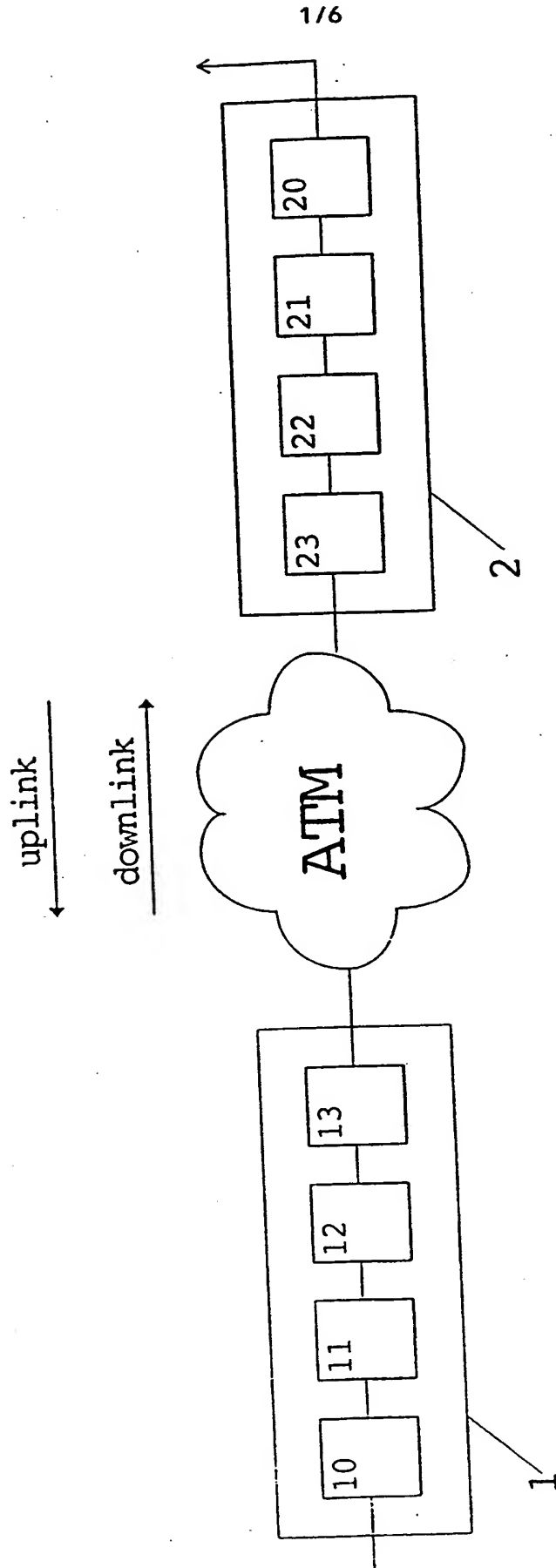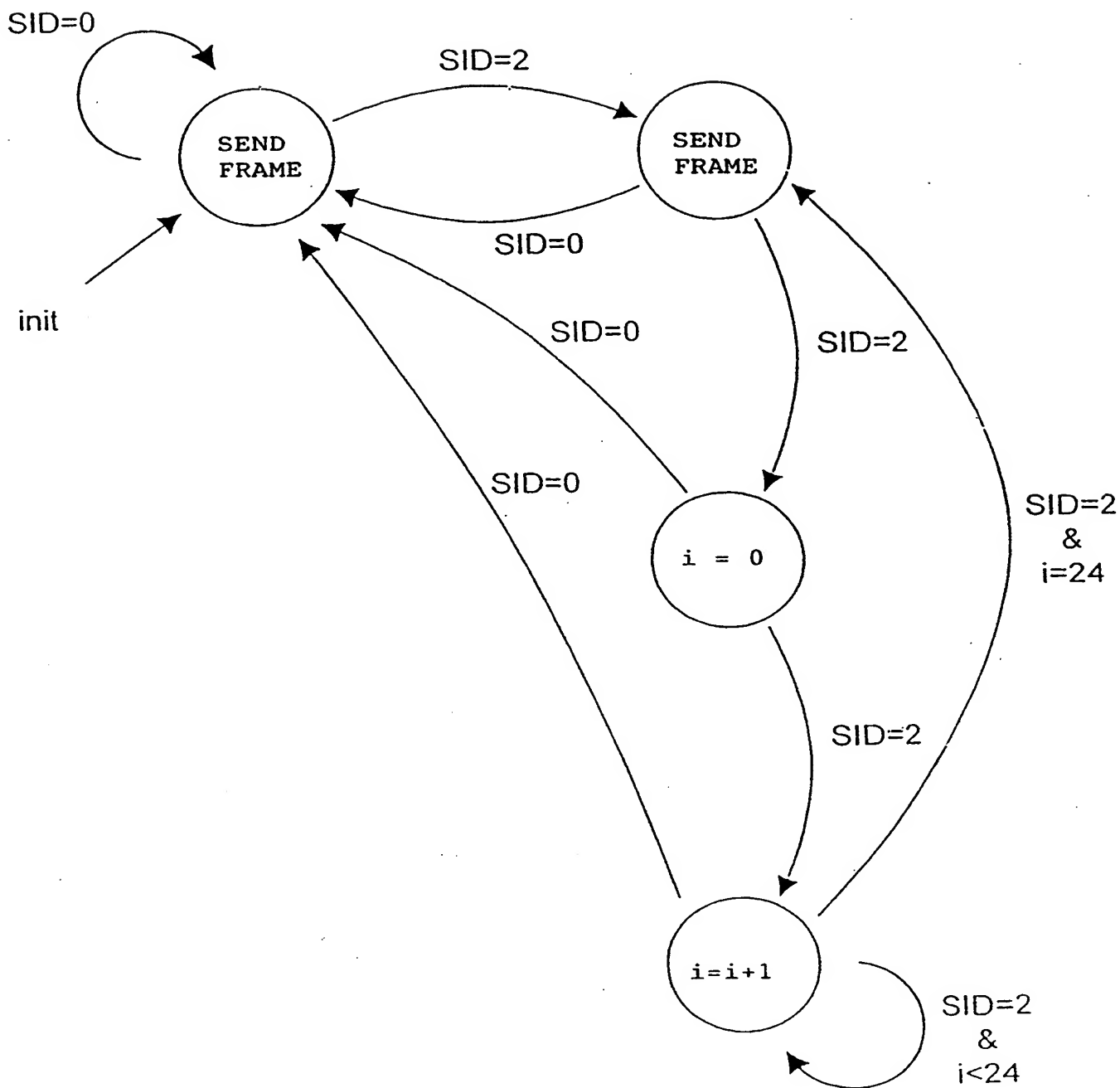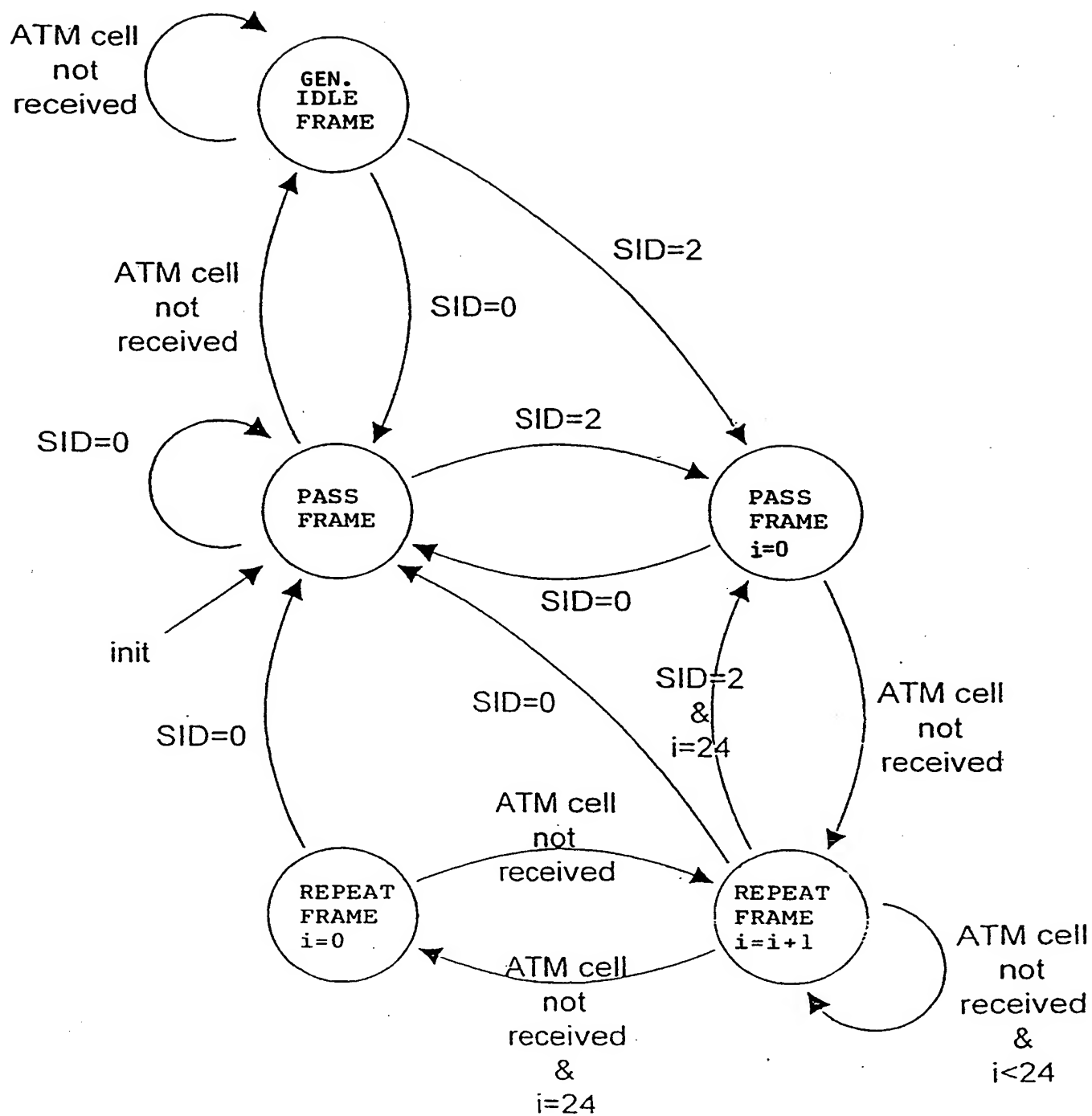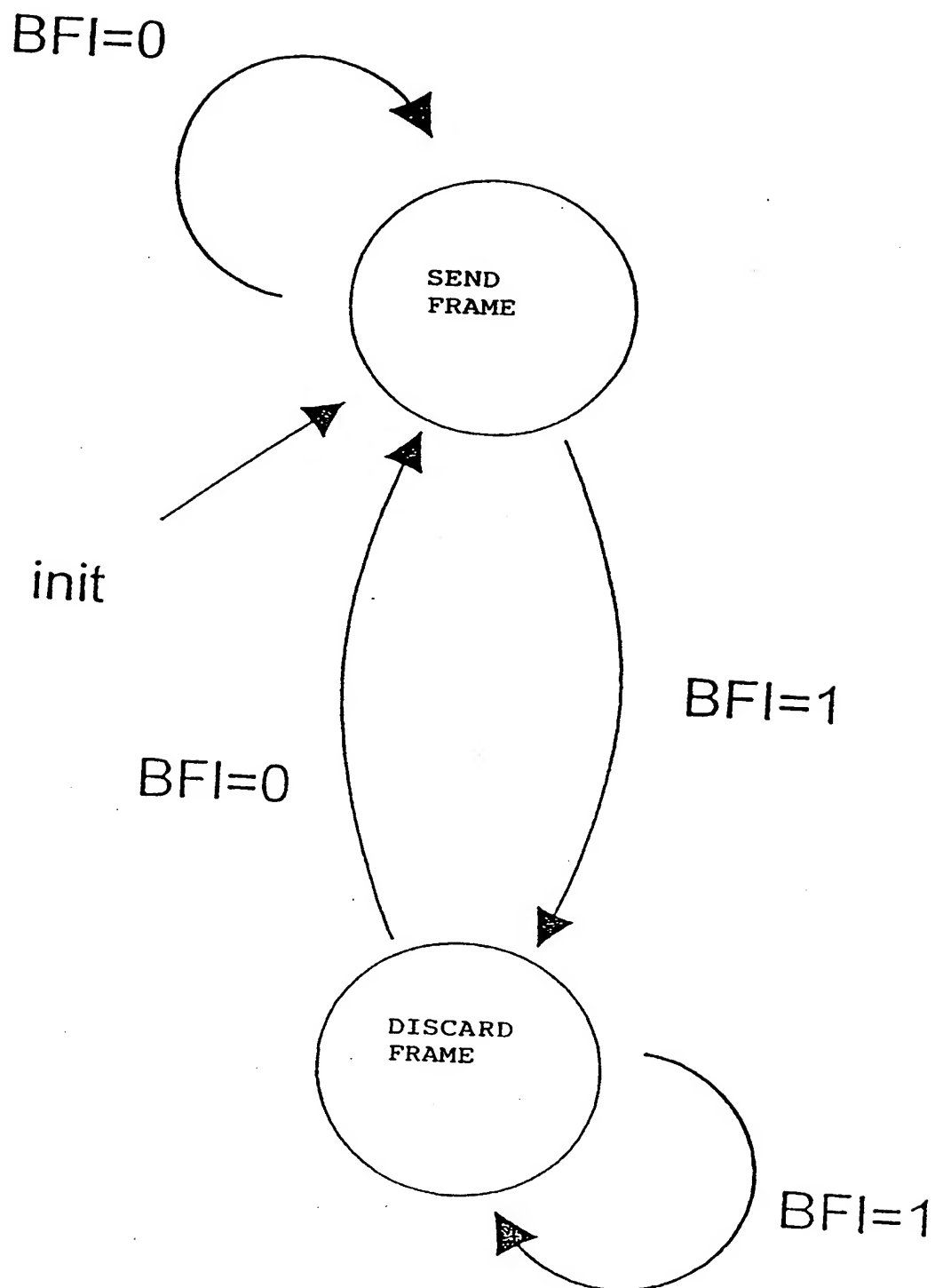5 speechless period in said downlink transmission.
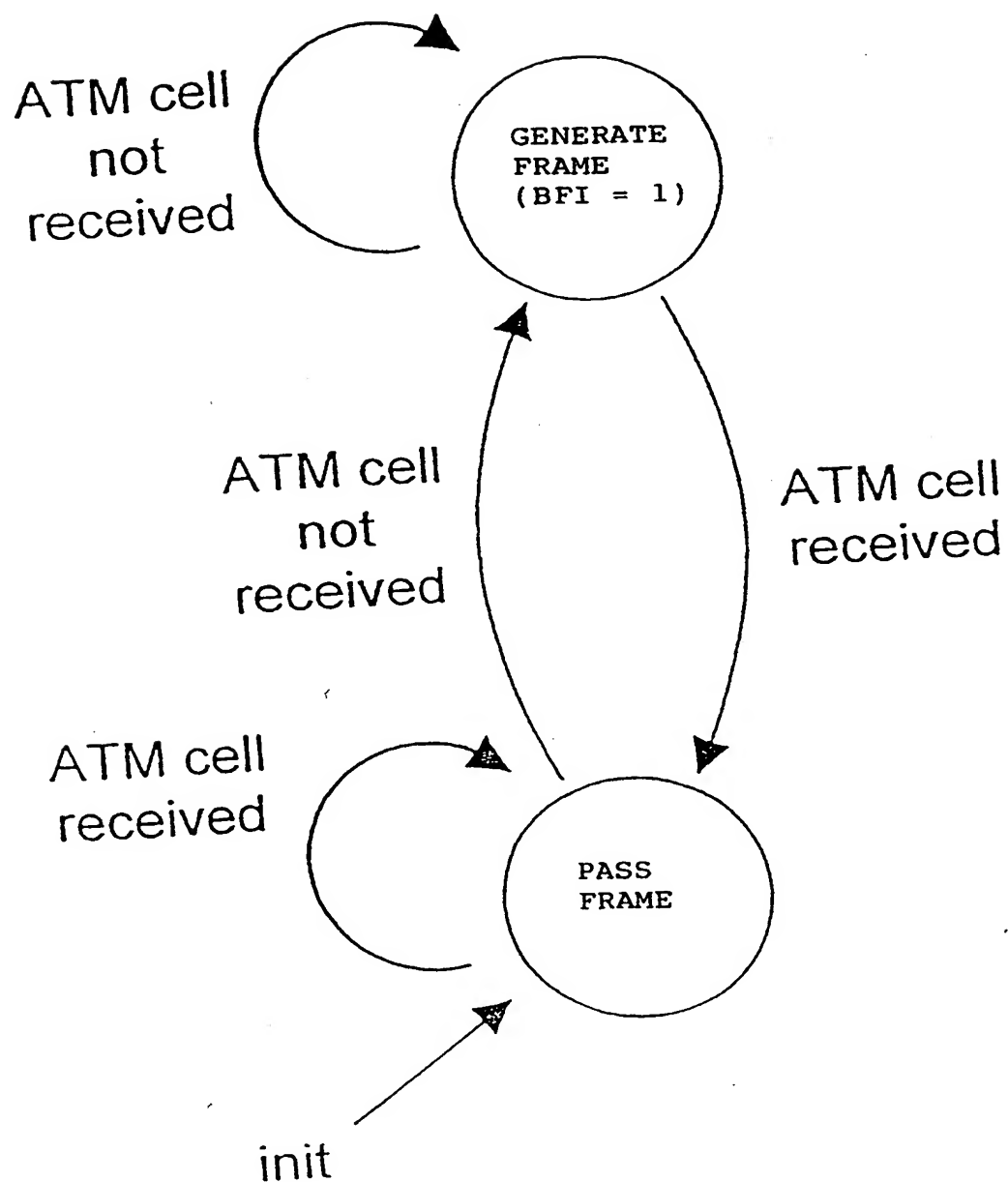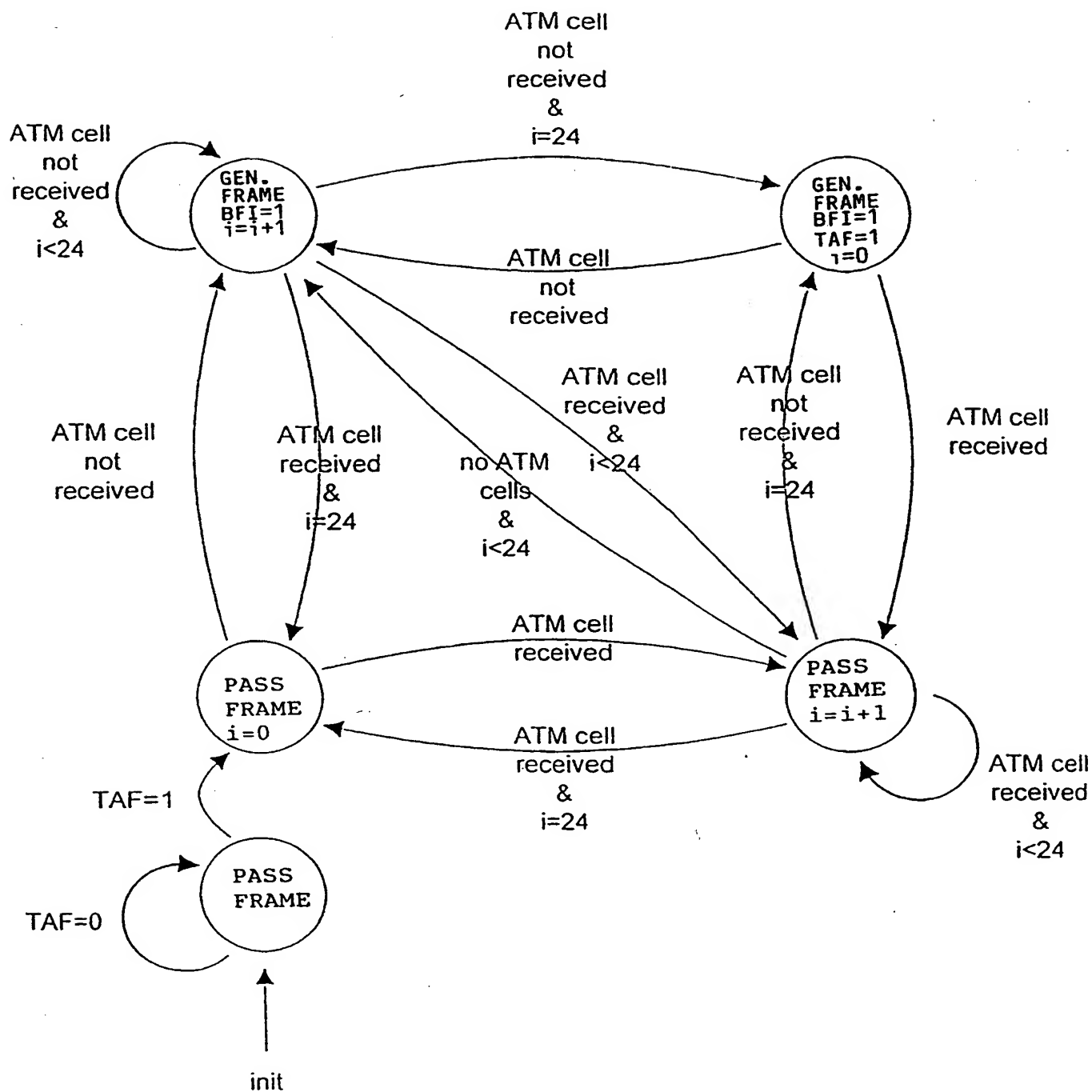
10

Fig. 1

Fig. 2

Fig. 3

BFI=0

SEND
FRAME

init

BFI=0

BFI=1

DISCARD
FRAME

BFI=1

Fig. 4

ATM cell
not
received

GENERATE
FRAME
(BFI = 1)

ATM cell
not
received

ATM cell
received

ATM cell
received

PASS
FRAME

init

Fig. 5

Fig. 6

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6   H04Q11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6   H04Q H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category°	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 810 757 A (NIPPON TELEGRAPH & TELEPHONE) 3 December 1997 see column 2, line 24 - column 4, line 27	1
A	EP 0 810 804 A (MITSUBISHI ELECTRIC CORP) 3 December 1997 see column 2, line 24 - line 50	1
A	EP 0 756 267 A (IBM) 29 January 1997 see column 1, line 21 - column 4, line 9	1-11

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 September 1998	11/09/1998

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Gregori, S

Form PCT/ISA/210 (second sheet) (July 1992)

1

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0810757	A	03-12-1997	CA	2204024 A	06-03-1997
			CN	1166251 A	26-11-1997
			WO	9708871 A	06-03-1997
EP 0810804	A	03-12-1997	JP	9321777 A	12-12-1997
			CA	2196126 A	01-12-1997
EP 0756267	A	29-01-1997	NONE		